

CLAIMS

1. In an integrated circuit (IC) digital communication relay device, a method for providing redundancy comprising:

5 receiving communications on a first receive path and a second receive path;

monitoring the first and second receive paths for communication integrity; and

10 selecting a receive path in response to monitoring the first and second receive paths for communication integrity.

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2. The method of claim 1 in which the communications are encoded with forward error correction (FEC); and

15 the method further comprising:

decoding the received communications

correcting byte errors in the decoded communications using the forward error correction; and

20 wherein monitoring the first and second receive paths for communication integrity includes monitoring the corrected byte errors in the decoded communications in the first and second receive paths.

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3. The method of claim 2 further comprising:

25 following selecting a path in response to monitoring communications, encoding the communications with forward error correction; and

transmitting the encoded communications.

4. The method of claim 3 wherein transmitting the encoded communications includes transmitting the encoded communications on a first transmit path and second transmit path; and the method further comprising:

5 monitoring the communications on the first and second transmit paths for communication integrity; and selecting a transmit path in response to monitoring communications integrity on the first and second transmit paths.

10 5. The method of claim 4 further comprising: decoding the transmitted communications correcting byte errors in the decoded transmitted communications using the forward error correction; and wherein monitoring the first and second transmit paths for communication integrity includes monitoring the corrected byte errors in the decoded transmit communications.

15 6. The method of claim 5 further comprising: selecting the first transmit path; monitoring the first transmit path for communication integrity; detecting communication integrity problems in the first transmit path; and switching to the second transmit path.

7. The method of claim 1 in which the communications are organized in a digital frame structure with overhead, payload, and forward error correction sections;

wherein monitoring the first and second receive paths
5 includes using the forward error correction to determine the bit error rate of the decoded communications; and

wherein selecting a receive path in response to monitoring the first and second receive paths for communication integrity includes selecting a receive path in response to the bit error rate.

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8. The method of claim 7 wherein monitoring the first and second transmit paths for communication integrity includes monitoring the overhead sections for frame synchronization bytes; and

15 wherein selecting a receive path in response to monitoring the first and second receive paths includes selecting a path in response to monitoring frame synchronization bytes.

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9. The method of claim 1 further comprising:

selecting the first receive path;

monitoring the first receive path for communication integrity;

detecting communication integrity problems in the first receive path; and

switching to the second receive path.

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10. In an integrated circuit (IC) digital communication relay device, a method for providing redundancy comprising:
receiving communications from a first node;
monitoring the received communications for communication
5 integrity; and
selecting a path from the first node in response to monitoring communication integrity.

11. The method of claim 10 further comprising:
10 transmitting the communications to a second node;
monitoring the transmitted communications for communication integrity; and
selecting a path to the second node in response to monitoring communication integrity.

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12. The method of claim 11 in which receiving communications from the first node includes receiving communications encoded with forward error correction (FEC); and

the method further comprising:
20 decoding the received communications
correcting byte errors in the decoded communications using the forward error correction; and
wherein monitoring the received communications for communication integrity includes monitoring the corrected byte errors in
25 the received and decoded communications.

13. The method of claim 12 further comprising:
following the decoding of the received communications,
encoding the communications with forward error correction; and
wherein transmitting the communications to a second node
5 includes transmitting encoded communications.

14. The method of claim 13 wherein transmitting the
encoded communications includes transmitting the encoded
communications on a first transmit path and second transmit path;
10 wherein monitoring the transmitted communications for
communication integrity includes monitoring the transmitted
communications on the first and second transmit paths for communication
integrity; and
selecting a transmit path to the second node in response to
15 monitoring communication integrity includes selecting a transmit path in
response to monitoring communications integrity on the first and second
transmit paths.

15. The method of claim 14 further comprising:
20 receiving the transmitted communications at the second
node; and
the method further comprising:
decoding the transmitted communications at the second
node;
25 correcting byte errors in the transmitted and decoded
communications, at the second node, using the forward error correction;

sending a status message from the second node with an indication of byte error corrections; and

wherein monitoring the transmitted communications for communication integrity includes receiving the status message from the 5 second node.

16. The method of claim 15 further comprising:

selecting the first transmit path;

monitoring the first transmit path for communication

10 integrity;

detecting communication integrity problems in the first transmit path; and

switching to the second transmit path.

15 17. The method of claim 16 wherein receiving

communications includes receiving communications on a first receive path and second receive path;

wherein monitoring the received communications for communication integrity includes monitoring the received

20 communications on the first and second receive paths for communication integrity; and

selecting a receive path in response to monitoring communication integrity includes selecting a receive path in response to monitoring communications integrity on the first and second receive 25 paths.

18. The method of claim 17 further comprising:
selecting the first receive path;
monitoring the first receive path for communication
integrity;

5 detecting communication integrity problems in the first
receive path; and
switching to the second receive path.

19. The method of claim 11 in which the communications
10 are organized in a digital frame structure with overhead, payload, and
forward error correction sections;

wherein monitoring communications includes monitoring
overhead bytes in the overhead section.

15 20. The method of claim 19 wherein monitoring the
overhead section for overhead bytes includes monitoring the overhead
sections for frame synchronization bytes.

21. An integrated circuit (IC) relay device to provide a
20 method for maintaining a high integrity communication path between
network nodes, the method comprising:

establishing a plurality of paths between a first node and a
second node;
monitoring the integrity of communications on the plurality
25 of paths; and
selecting the paths with the highest integrity.

22. An integrated circuit (IC) digital communication relay device for providing redundancy, the device comprising:

a receive monitor having a first input connected to a first receive path and a second input connected to a second receive path, the receive monitor monitoring the integrity of communications on the first and second receive paths and supplying a control signal responsive to the communication integrity at a first output, the receive monitor supplying the communications from the first receive path to a second output and communications from the second receive path to a third output; and

5 a receive switch having a first input connected to the receive monitor second output, a second input connected to the receive monitor third output, and a third input connected to the receive monitor first output, and an output to supply communications from the selected input

10 10 communications from the second receive path to a third output; and

15 a receive switch having a first input connected to the receive monitor second output, a second input connected to the receive monitor third output, and a third input connected to the receive monitor first output, and an output to supply communications from the selected input

in response to the control signal.

23. The device of claim 22 in which the received communications are digital frame structures having overhead, payload, and forward error correction sections; and

20 wherein the receive monitor monitors integrity criteria selected from the group including overhead bytes, synchronization status, loss of clock, bit error rate, and signal to noise ratio.

24. The device of claim 22 further comprising:

25 a transmit switch having a first input to accept communications for transmission, a second input to receive a control

signal, a first output, and a second output to selectively supply communications in response to the control signal; and

5 a transmit monitor having a first input connected to the transmit switch first output and a second input connected to the transmit switch second output, the transmit monitor monitoring the integrity of communications on the first and second inputs and supplying a control signal responsive to the communication integrity at a first output, the transmit monitor supplying the communications from the first input to a first transmit path and communications from the second input to a second

10 transmit path.

25. The device of claim 24 further comprising:

a transmitter having an input to accept communications for transmission and supplying the communications on a first output connected to the transmit switch first input.

26. The device of claim 25 in which the transmitted communications are digital frame structures having overhead, payload, and forward error correction sections; and

20 wherein the transmit monitor monitors integrity criteria selected from the group including overhead byte recognition, frame synchronization bytes, clock loss, bit error rate, and signal to noise ratio.

27. The device of claim 25 wherein the transmit monitor has a third input to receive status messages concerning the integrity of communications transmitted on the first and second transmit paths;

wherein the transmit monitor supplies control signals responsive to the received status messages; and

wherein the transmit switch selects an output in response to the status messages received at the transmit monitor third input.

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28. The device of claim 27 in which received communications are encoded with forward error correction (FEC);

the device further comprising:

10 a receiver having an input connected to the receive switch output to process communications, the receiver having an output to supply processed communications received on the selected receive path;

15 a decoder having an input selectively connected to the receiver output and an output to supply decoded communications, where byte errors in the decoded communications have been corrected using the forward error correction; and

an encoder having an input selectively connected to the decoder output, and an output connected to the transmitter input to supply encoded communications with forward error correction.

20 29. The device of claim 28 wherein the receive monitor has a third input connected to the decoder output, the receive monitor supplying a receive switch control signal in response to the number of byte error corrections made by the decoder; and

25 wherein the receive switch selects an input in response to the number of byte error corrections.

30. A system of integrated circuit (IC) digital communication relay devices for providing redundancy, the system comprising:

a first relay including:

5 a transmit switch having a first input to accept communications for transmission, a second input to receive a control signal, a first output, and a second output to selectively supply communications in response to the control signal; and

10 a transmit monitor having a first input connected to the transmit switch first output, a second input connected to the transmit switch second output, and a third input to receive communication integrity status messages, the transmit monitor monitoring the integrity of communications on the first and second inputs and supplying a control signal responsive to the communication integrity at a first output, the transmit monitor supplying the communications from the first input to a first transmit path and communications from the second input to a second transmit path;

15 a first receiver node having an input connected to the transmit monitor second output to receive communications and an output connected to third input of the first relay transmit monitor to supply status messages concerning the integrity of the received communications; and

20 a second receiver node having an input connected to the transmit monitor third output to receive communications and an output connected to the third input of the first relay transmit monitor to supply

status messages concerning the integrity of the received communications; and

wherein the transmit monitor supplies a control signal to select a transmitter switch output in response to the status messages from 5 the first and second receiver nodes.

31. A system of integrated circuit (IC) digital communication relay devices for providing redundancy, the system comprising:

10 a receive monitor having a first input connected to the first receive path and a second input connected to the second receive path, the receive monitor monitoring the integrity of communications on the first and second receive paths and supplying a control signal responsive to the communication integrity at a first output, the receive monitor supplying 15 the communications from the first receive path to a second output and communications from the second receive path to a third output; and

a receive switch having a first input connected to the receive monitor second output, a second input connected to the receive monitor third output, and a third input connected to the receive monitor first 20 output, and an output to supply communications from the selected input in response to the control signal;

a first transmitter node having an output connected to the receive monitor first input to transmit communications;

a second transmitter node having an output connected to the 25 receive monitor second input to transmit communications; and

wherein the receive monitor supplies a control signal to select a receive switch input in response to monitoring communication integrity.